REPORT OF A CASE OF PATHOLOGICAL SEPARATION OF THE LOWER EPIPHYSIS OF THE FEMUR.[1]

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SEPARATION of an epiphysis is a condition that may occur either on account of trauma or disease. There seems to be a difference of opinion by writers as to the frequency of its occurrence, especially as the result of trauma. As the result of disease of the bones, osteomyelitis, it is considered a not infrequent accident. Bruns[2] has collected 81 reported cases. Of these cases 28 were of the lower end of the femur. Next in order came the lower end of the radius, 25 cases; the lower end of the tibia and the upper end of the humerus, each 11 cases. The ages recorded in 52 cases were 8 between one and nine years, 44 between ten and nineteen years, the greatest frequency being at the sixteenth year. Marquat[3] collected 106 cases, 20 of which were of the lower end of the femur. The ages were between birth and the sixteenth year.

From the above statistics we see that the traumatic separation of the lower end of the femur occurs in about one-fifth to one-third of all the reported cases; in the majority of cases previous to the sixteenth year, seldom later.

The forces that are necessary to produce this separation are various. Thus, during childbirth, traction may produce it. Volkmann states that he has produced it when the hip is diseased, when making rotation in seeking for crepitation or extension in the application of plaster-of-Paris dressings. Other forces are, in direct external violence, usually of a twisting character, or lateral or at right angles to the axis of the limb.

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[1] Read before the Mississippi Valley Medical Association at Hot Springs, Ark., November 19, 1894.

[2] Hand-Book of the Medical Sciences, Vol. III, p. 234.

[3] Stimson, p. 539.

It is of interest, in relation to these cases, to note the various opinions as to the direction of the dislocation of the ends of the separated epiphysis. Tillmans states that in the majority of cases the epiphysis is pushed forward and the diaphysis backward into the popliteal space. The same condition prevails according to the observations of cases as reported by Coural, Little, Voss, Buck;[1] Kœnig also notes the same direction of the fragments, very seldom the opposite. The readiness with which the dislocation of the separated diaphysis into the popliteal space occurs can be explained (1) on account of the anatomical structures of the surrounding parts; (2) the force and position of the patient; the popliteal space being the direction of least resistance, while on the anterior aspect we have the strong quadriceps tendon, the patella, and the ligamentum patellæ. The patient being usually on the feet at the time of the accident and in the process of falling forward or sidewise, may also determine the direction of the shaft pushing the lower end in a downward and backward direction. This backward dislocation of the diaphysis, as far as the prognosis of the case is concerned, is of importance, on account of the pressure that may be brought to bear on the popliteal vessels, interfering with the circulation so that amputation becomes necessary, as in several of the cases on record. On the other hand, where the diaphysis is pushed forward onto the trochlear surface of the condyles, the popliteal vessels are not as liable to be disturbed in their normal relation, and are protected from pressure by retaining their normal relation to the intercondyloid notch of the condyles.

The occurrence of pathological separation of the epiphyses is regarded by writers on surgical pathology and diseases of the bones as a not infrequent accident in diseases of the bones and joints. It is noted in osteomyelitis of the long bones. It occurs in consequence of necrosis, inflammatory osteoporosis, or molecular disintegration of bone in the epiphyseal line.[2] The time of the separation is about the fifth or sixth week. In Billroth's "Surgical Pathology" a case is cited of separation of the lower end of the femur, analogous to the one I report.

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[1] Hamilton, Fractures.

[2] Senn.

On account of the comparative rarity of diseases of the bones in this country, the opportunity of observing pathological separation of the epiphysis is quite rare. The following case of pathological separation of the lower end of the femur is therefore of interest.

Lena B., aged thirteen; a resident of Welden Springs, Mo., was admitted to Rebekah Hospital October 8, 1894, with the following history: About the 11th day of November, 1892, the right knee began to be painful. Five days later the knee began to swell. Six weeks later the knee was lanced on inner aspect, giving vent to a free discharge of pus. Two months later knee was lanced a second time, but with little discharge of pus. In March, 1893, the bone began protruding through the skin. Since the second lancing pieces of bone were discharged through the wounds. The leg had not at any time been placed in a position of rest on a splint.

Her maternal grandfather and several maternal aunts died of consumption. Her father's family were healthy. Both her parents were living and well.

The patient is a pale, blue-eyed, flaxen-haired child, with very delicate skin. When admitted her temperature was normal; body emaciated. The right knee was flexed at an obtuse angle; joint ankylosed. The knee was symmetrically enlarged, and of smooth surface. On the anterior aspect of the knee there was a bony protrusion three-fourths of an inch in diameter and projecting a distance of an inch or more beyond the level of the skin. The bone protruding was immovable, necrosed, and black. At the lower surface of the protruding bone there was a broad splinter of bone which could be pushed to and fro, inward and outward in the axis of the limb. The skin around the bone was bound to its base by scar tissue. On the inner aspect of the knee was a fistulous opening through which the bone beneath could be felt by a probe. The component structures of the joint could not be outlined by palpation, the whole feeling like a solid symmetrical tumor. Manipulation was not painful, neither did the child complain of pain in the knee. (Figs. 1 and 2.) A resection of the knee was decided on.

On October 12, 1894, I performed the following operation: First, two incisions were made following the axis of the limb, beginning below the tuberosity of the tibia and carried above the condyles of the femur, the one on the internal aspect of the limb, the other on the outer aspect. Two elliptical incisions were made across the knee, both beginning at the inner lateral incisions, diverging, the one below the other above the protruding necrosed bone, and converging

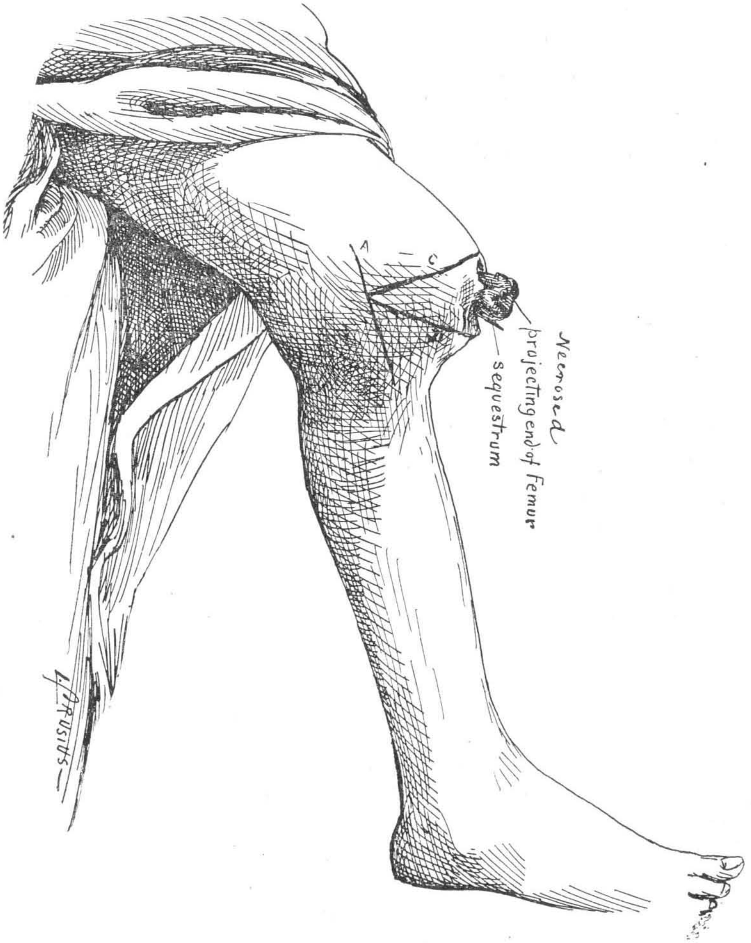

FIG. 1 (drawn from photograph).—Shows end of necrosed femur projecting and a sequestrum beneath the outer side of knee; *A*, *C*, *D*, line of incision through the skin.

at the outer lateral incision. In the ellipse thus formed on the anterior surface of the knee were included the protruding portion of bone, scar tissue surrounding the same, and an elliptical portion of normal skin. All of the incisions were made down to the bony

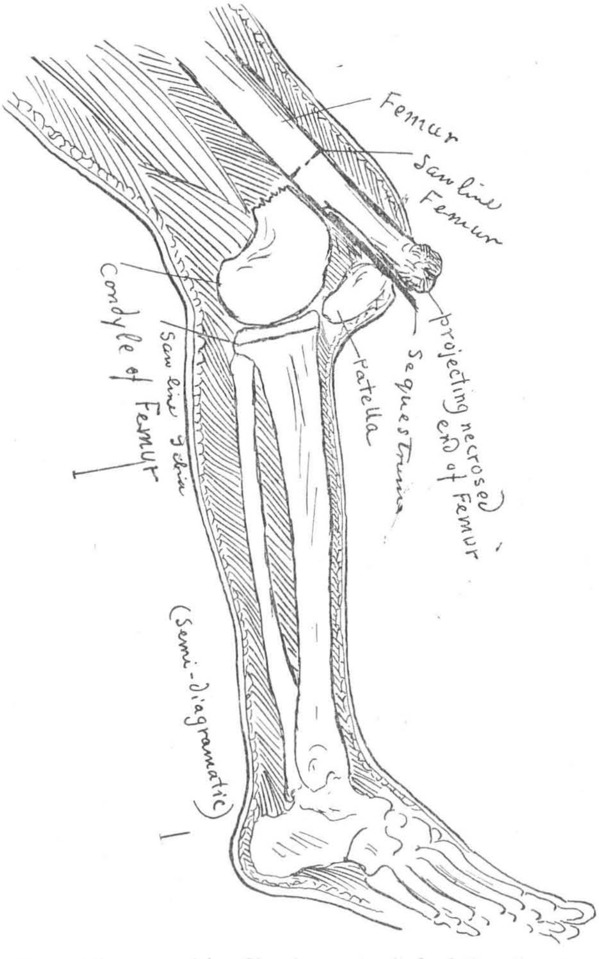

FIG. 2 (diagrammatic).—Showing anatomical relation of parts.

structures with a strong resection knife. The incisions thus modified are practically the **H** incisions of Moreau, as practised by Ollier. The reason for my making the incisions as outlined—aside from the condition of the parts preventing the incisions of Hahn, Volkmann, Langenbeck or Textor—was the fact that I wanted to obtain the specimen in its entirety, without destroying the ankylosed joint surfaces. The next step in the operation was the dissecting up of the lower flap, as outlined by the lower elliptical incision and the lower halves of the lateral incisions. This flap was dissected up to below the tuberosity of the tibia. The upper flap, outlined by the upper halves of the lateral and the upper elliptical incision, was dissected up to above the condyles (upper part of the tumor). The bone on the anterior and lateral aspects of the knee was now clear of the soft parts, the popliteal space remaining not interfered with. The next step was to saw through the head of the tibia, freeing the leg. This being done the whole leg was elevated. By means of the knife and elevator the soft parts of the popliteal space were detached from the back part of the knee up to a point where it was intended to saw through the femur. The femur was sawed through as nearly above the condyle as possible. I found in the saw-cut in the end of the femur a cavity lined with fungous granulations, which I removed with a bone curette. I found that into this cavity had projected the upper end of the splinter of bone, which also protruded from the under surface of projecting bone at the front of the knee-joint. I drilled the ends of the tibia and femur and wired them with silver wires.

I found that the soft parts coaptated perfectly. The transverse wound was closely sutured with silk; likewise the upper and lower halves of the lateral wounds. Through the centre of the popliteal space, from side to side, I carried a small-sized rubber drainage-tube. Dressing of iodoform gauze and cotton, and over all plaster of Paris from foot to buttocks.

Reacted well from chloroform. No abnormal temperature until after third day, October 16; morning temperature 100$\frac{2}{5}$° F., evening temperature 102$\frac{2}{5}$° F. Removed dressing, took out drainage-tube, leaving small pieces in either side of wound. Opened bowels by saline purge.

Until October 22, temperature normal to 99$\frac{3}{5}$° F. Wound healed by first intention, except at lower angles and a small stitch abscess in transverse wound.

Progress throughout favorable; at end of third week wounds all healed.

November 14. Patient sits up in bed. Temperature normal; appetite good; sleeps well, and has gained markedly in flesh. Limb still in plaster dressing. Bony union perfect.

[Patient discharged from hospital January 7, 1895, walking on limb; raised shoe; braces extended onto thigh; shortening 4½ inches.]

A careful study of the specimen after removal developed the following facts: The necrotic portion of bone protruding from the anterior aspect of the knee is continuous with the shaft of the femur. At the junction of the necrotic portion with the healthy part of the femur, and corresponding to the site of scar tissue, there is a constriction, or, in other words, a line of demarcation on the bone. The broad splinter extends the whole length on the inner side, from the tip of the protruding bone to the site where the femur was sawed through. The length of normal femur removed and necrotic bone is about three inches. Immediately under the shaft of the femur are the condyles, on the posterior surface of which is the head of the tibia in an ankylosed condition. The under surface of the femur is bound down firmly to the upper surface of the condyles; or, in other words, the shaft overrides the condyles. The condyles are apparently normal. Immediately below the projecting end of the femur and the head of the tibia is situated the patella, displaced a little to the left. No evidence of new formation of bone or pathological changes. The patellar ligament has been changed to a mass of fatty tissue by fatty degeneration. Patella healthy.

From the foregoing study of the specimen, we can draw the following conclusions as to what had taken place,—viz., separation of the epiphysis—epiphyseolysis, as Senn calls it—as a result of an osteomyelitis at the epiphyseal line; displacement of the epiphysis into the popliteal space; overriding of the epiphysis by the femur; displacement of the patella; and, finally, crowding forward of the end of the femur, perforating the skin and continuing to be pushed forward until firmly fixed by inflammatory processes. Inflammatory infiltration about the joint structures followed, so as to render a recognition externally by palpation impossible. Gradual discharge of parts of necrosed bone through fistular openings remaining. A sequestrum remaining on the lower surface of femur, as well as necrosed end, corresponding to the site of osteomyelitis at the epiphyseal line.

REMARKS.

In considering traumatic separation of the epiphysis of the lower end of the femur the mechanism was explained, and it was shown that the diaphysis, in the majority of cases, was crowded into the popliteal space. In this specimen, and in an analogous case quoted by Billroth, the opposite displacement obtains. The explanation of the manner in which this takes place, to my mind, is the following: The shaft of the femur at the epiphyseal line was the seat of an osteomyelitis. The surrounding structures, especially the joint, may be either specifically or non-specifically involved. We know that flexion of a joint, especially of the knee, takes place whenever there is inflammation in or about it for any length of time, if not prevented by apparatus, such as splints, methods of extension, etc. This took place, and as the case ran on ankylosis (temporary at first) took place, with the knee in a flexed position. By the time separation occurred (about the sixth week) the knee was pretty firmly ankylosed. Granting, now, we have separation of the epiphysis, the leg cannot be elevated by the will of the patient, the thigh being only partially under the control of the will. The leg is not supported except imperfectly by pillows; the occasion to move the patient perhaps frequent. Now, whenever the leg is raised the condyles, being fixed to the tibia, move with it. Owing to the angle that the tibia occupies to the condyles whenever the leg is elevated, the epiphyseal line of the condyles is depressed into the popliteal space and favors the slipping of the end of the femur upon the trochlear surface of the condyles. The action of the thigh muscles, which are attached to the head of the tibia, draws the leg upward with the condyles so that the femur overrides the same. The displacement having occurred, the action of the thigh muscles continues pushing the femur end through the skin, having first pushed the patella and tendon aside. This crowding down of the femur continues until it becomes fixed in this position by inflammatory action. The action of the muscles attached to the neck and trochanters of the thigh-bone also elevates the end of the femur and favors its overriding the trochlear surface of the condyles.

Another question which arises when viewing this case is the following: Is the deformity in this case, due to a separation of the epiphyseal line, a necessary sequence to the osteomyelitis? This may be answered in the negative. If not, how can it be prevented, and how does nature remedy the damage done? The first indication is to keep the parts at rest on proper splints, so as to prevent flexion and movement. If separation does occur, displacement will not take place readily if proper splints and extension have been applied. We well know that nature attempts to be conservative, and we also understand the manner in which she does it. New-formation bone-material is thrown out around the dead bone, forming a casing around it and leaving the dead bone, the sequestrum, on the inside. It is, therefore, possible that the separated epiphysis becomes again united to the shaft by means of the callus thrown out,[1] and that after the sequestrum has been removed—either by nature or by the aid of the surgeon—the limb may again become useful. The proper treatment of inflammation of bone is too well understood to merit attention here.

One important question in a case such as we are dealing with is, Is excision or amputation the preferable operation? When we refer to the statistics of knee resections for tuberculosis, the favorable results obtained are certainly an answer in favor of resection. In cases of typical resection of the knee the epiphyseal cartilages are avoided and subsequent shortening in many cases is not marked. In this case they have been sacrificed and shortening must be expected. In a child amputation would leave a stump that would become small and atrophied, and it would be questionable if an artificial limb could be adapted that would be comfortable and useful. In resection, the long posterior thigh muscles have been in part preserved, and will, to a certain degree, reacquire physiological function. A subsequent amputation when the patient is grown would yield a better stump for the adaptation of an artificial leg than now. In the adult the question of resection or amputation must be considered according to the individual peculiarities of the case. The question, however, is a wide one, and open to much discussion *pro* and *con*.

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[1] Billroth.